IT IS CLAIMED:

1. A device for use with a centrifuge for fragmenting solute or particulate material contained in a liquid sample, said device comprising

a substrate adapted to be supported within a centrifuge tube,

formed in said substrate, a microchannel extending between upper and lower channel ends and defining a plurality of shear regions, each designed to subject material present in the sample liquid to a shearing force as sample liquid is forced through the shear region under the influence of a selected centrifugal force applied to the tube in which the device is supported,

wherein material contained in a liquid sample applied to the upper end of the microchannel, with the device supported in a centrifuge tube within a centrifuge, is fragmented by shearing as the sample is forced successively through the plurality of shear regions in the microchannel, when the selected centrifugal force applied to the tube.

2. The device of claim 1, which further includes a holder adapted to be received within a selected-size centrifuge tube, and adapted to support said substrate within the tube.

3. The device of claim 1, wherein said substrate includes support members constructed to support the substrate within a selected-size centrifuge tube.

4. The device of claim 1, which is formed as an integral unit with a centrifuge tube.

5. The device of claim 1, wherein the microchannel includes at least 5 shear regions.

6. The device of claim 1, wherein the microchannel has a serpentine shape.

7. The device of claim 1, wherein said device includes a sample-receiving well and a fluid-flow barrier interposed between the well and the microchannel, for preventing liquid sample applied to the well from reaching the upper end of the microchannel until a selected centrifugal force is applied to the device.

8. The device of claim 7, wherein said barrier includes deformable members which remain interlocked at a channel-sealing condition until deformed under the selected centrifugal force.

9. The device of claim 7, wherein said barrier includes a frangible seal designed to fracture when a liquid sample is forced against the seal under the selected centrifugal force.

10. The device of claim 7, wherein said barrier includes an electronically controlled valve which can be externally activated, from a closed to an open condition, when an external signal is applied to the valve.

11. The device of claim 1, wherein shear regions in the microchannel are defined by a change in the cross-sectional area of the channel, in a direction substantially perpendicular to the direction of fluid flow in the channel.

12. The device of claim 11, wherein a shear region is defined by adjacent upstream and downstream channel segments having a ratio of cross-sectional areas of at least 3:1.

13. The device of claim 12, wherein said upstream channel segment includes a central baffle which acts to prevent liquid flow through a central portion of that channel segment.

14. The device of claim 12, for use in fragmenting polynucleotide molecules, wherein the downstream segment in a microchannel has a width dimension of less than 20 microns.

15. The device of claim 1, wherein shear regions in the microchannel are defined by changes in the direction of liquid flow in the microchannel.

16. The device of claim 1, wherein shear regions in the microchannel are defined by physical barriers placed in the path of liquid flow in the microchannel.

17. The device of claim 1, wherein the substrate includes a plurality of different microchannels, each defining a plurality of shear regions along their lengths.

18. A polymer-fragmentation kit designed for use with a centrifuge for fragmenting a sample solution of polymers, such as polynucleotides, into a plurality of polymer-fragment pools, each with a different fragment-size range, comprising

a plurality of fragmentation devices, each device comprising

(i) a substrate adapted to be supported within a centrifuge tube,

(ii) formed in said substrate, a microchannel extending between upper and lower channel ends and defining a plurality of shear regions, where the shear regions in each device have a device-specific shear-region geometry designed to subject material present in the sample solution of polymers to a device-specific shearing force as sample solution is forced through the shear region under the influence of a selected centrifugal force applied to the tube in which the device is supported,

wherein polymers contained in a liquid sample applied to the upper ends of different devices in the kit, with the devices supported in centrifuge tubes within a centrifuge, are fragmented by shearing as the samples are forced successively through the plurality of shear regions in each device, to produce polymer fragments having different size ranges.

19. The kit of claim 18, wherein one or more of the devices includes a substrate having a plurality of different microchannels, each microchannel defining a plurality of shear regions along their lengths.

20. A method for use with a centrifuge for fragmenting solute or particulate material contained in a liquid sample, said method comprising

applying the sample solution to an upstream region of a microchannel device having a microchannel defining a plurality of shear regions, and

with the microchannel device supported within a centrifuge tube in the centrifuge, subjecting the tube to the selected centrifugal force, wherein sample material is fragmented by shearing as the sample is forced successively through the plurality of shear regions in the microchannel.

21. The method of claim 20, for processing a plurality of samples at the same time, wherein said applying includes applying one or more sample solutions to each of a plurality of such microchannel devices, each supported within a different tube in a centrifuge.

22. The method of claim 21, wherein each of the plural microchannel devices has a microchannel whose shear regions are defined by different, device-specific channel geometries, such that the same sample applied to different devices is subjected to different shear forces under the same centrifugal force.

23. The method of claim 20, wherein the centrifugal force to which the microchannel device is subjected is between 5000 and 27,000G.

24. The method of claim 23, wherein the centrifugal force to which the microchannel device is subjected is between 10,000-16,000 G.

25. The method of claim 23 or claim 24, wherein the total time over which the centrifugal force is applied is less than 1 minute.

26. The method of claim 18, wherein the sample volume added to the microchannel device is between 5 and 200 µl.

27. The method of claim 20, wherein sample material is forced through said microchannel only when the selected centrifugal force to which the tube is subjected reaches the selected centrifugal force.

28. The method of claim 20, for use in fragmenting polymer molecules, wherein the centrifugal force to which the tube is subjected is such, in relation to the geometry of the microchannel shear regions, to cause shear forces that fragment the polymer molecules into the desired size range under the influence of the selected force.

29. The method of claim 20, for use in assaying an intracellular analyte in a cell sample, wherein movement of the cell sample through the microchannel, under the influence of a selected centrifugal force to which the tube is subjected, is effective to disrupt the cells and release intracellular contents.

30. The method of claim 20, for use in forming desired size lipid particles in a particle suspension, wherein movement of the particles through the microchannel, under the influence of a selected centrifugal force to which the tube is subjected, is effective to produce the desired lipid-particle sizes.

31. The method of claim 30, wherein the lipid particles comprises liposomes and the method is used to produce liposomes of desired size distribution or lamellar structure.

32. The method of claim 18, for use in study of DNA replication, repair, and transcription, wherein DNA is randomly fragmented to produce short functionally distinct segments that are used in the study of binding and binding conditions of compounds that interact with DNA.